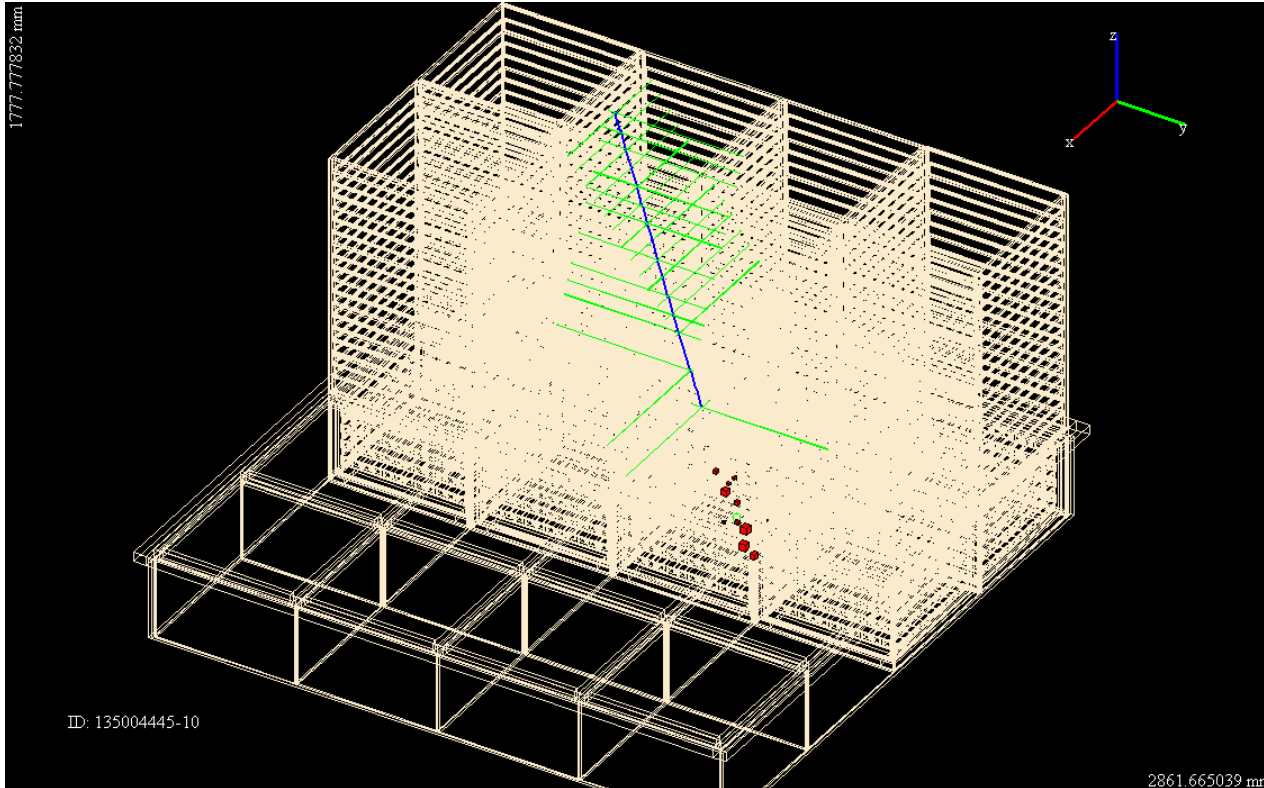
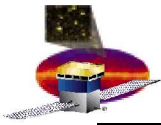


# GEM Discarded Events



Anders W. Borgland

Science  
Verification,  
Analysis and  
Calibrations

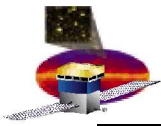


# Outline

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- What are the GEM discarded events
- Number of discarded events per read out event
- Time distribution of the discarded events
- STR results:
  - STR 33
  - STR 35
- CAL CPT runs
- Summary

**A lot of people have been involved in this analysis:  
Warren, Eric, Jim, Mike, Eric, .....**

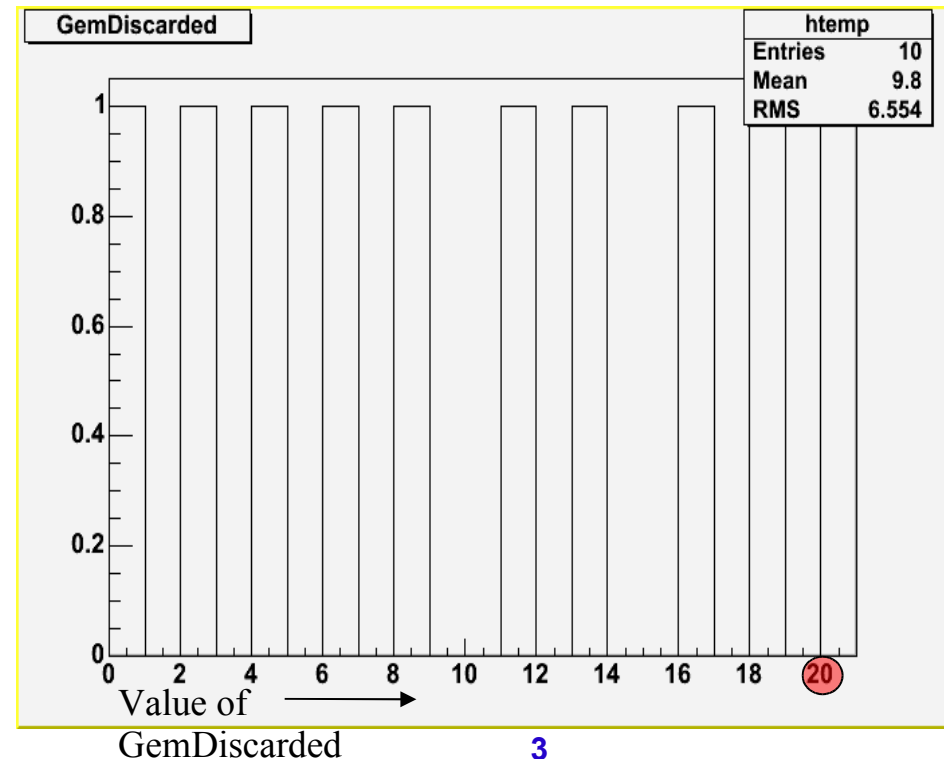


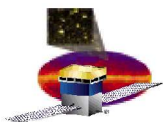
# GEM Discarded Events

- **GEM discarded events:**
  - A counter that keeps track of how many times the trigger window turned, but the LAT was busy.
- We may have discarded events under normal data taking:
  - Two physics events coming close to each other, and the LAT is busy reading out the first one
  - Periodic trigger fires while we read out an event
- **But the rate should be very low!**

GEM Discarded counter for →  
first 10 events of run 135004445

We have **20 discarded events**  
for the first 10 events that were read out!  
There is also a pattern here .....



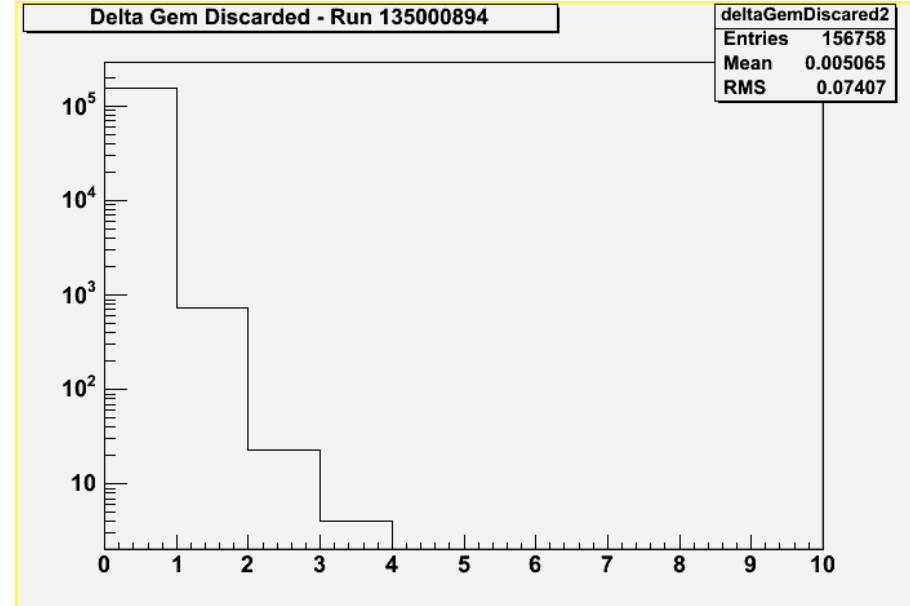
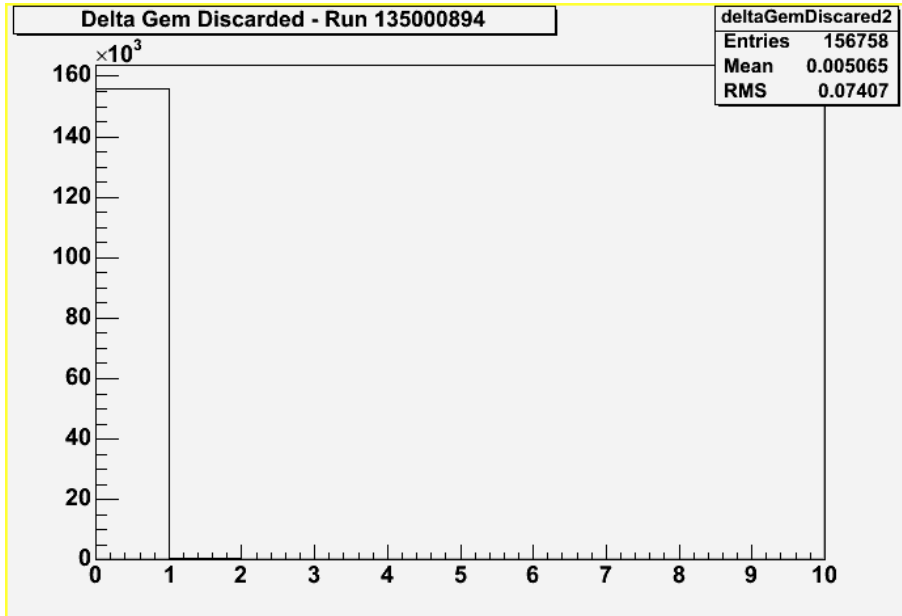


# Plots: Part I

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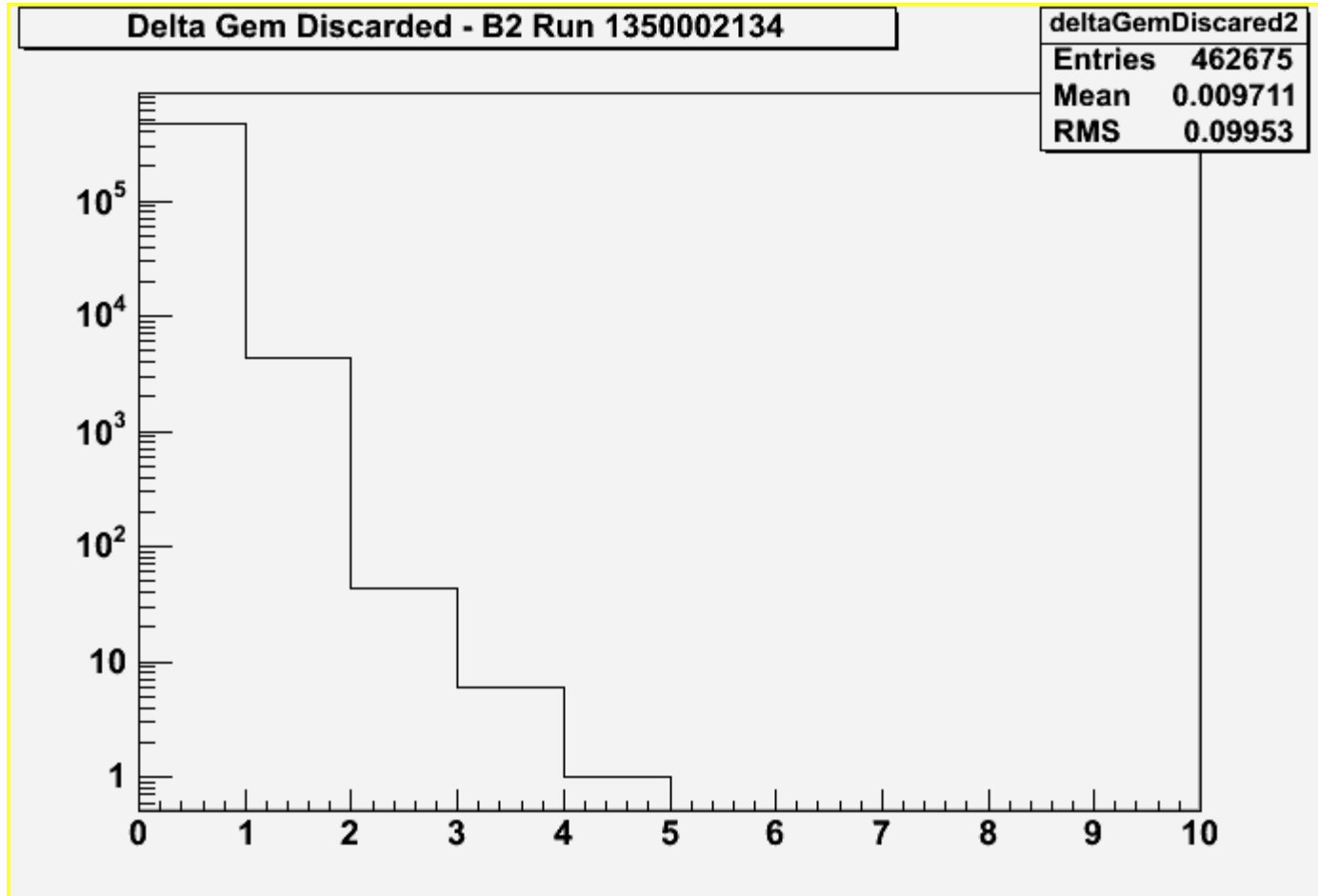
- I will plot how much the GEM discarded counter increases from one read out event to the next read out event:
  - **Delta Gem Discarded**
- Will show you plots for:
  - **Different number of towers in the grid:**
    - 1, 2, 4, 6 and 8 towers
  - **Different run types:**
    - B2 and 1-1: Flight configuration
    - B10: CAL 4-range readout
- Deadtime is different for the different run types:
  - **B2 : 529 ticks**
  - **B10: 1309 ticks**
- Remember:
  - **It's only a discarded event if it occurs inside the dead time!**

# One Tower Data: End2End 1-1



Delta GemDiscarded peaks at 0.  
0.5% of the read out events have discarded events

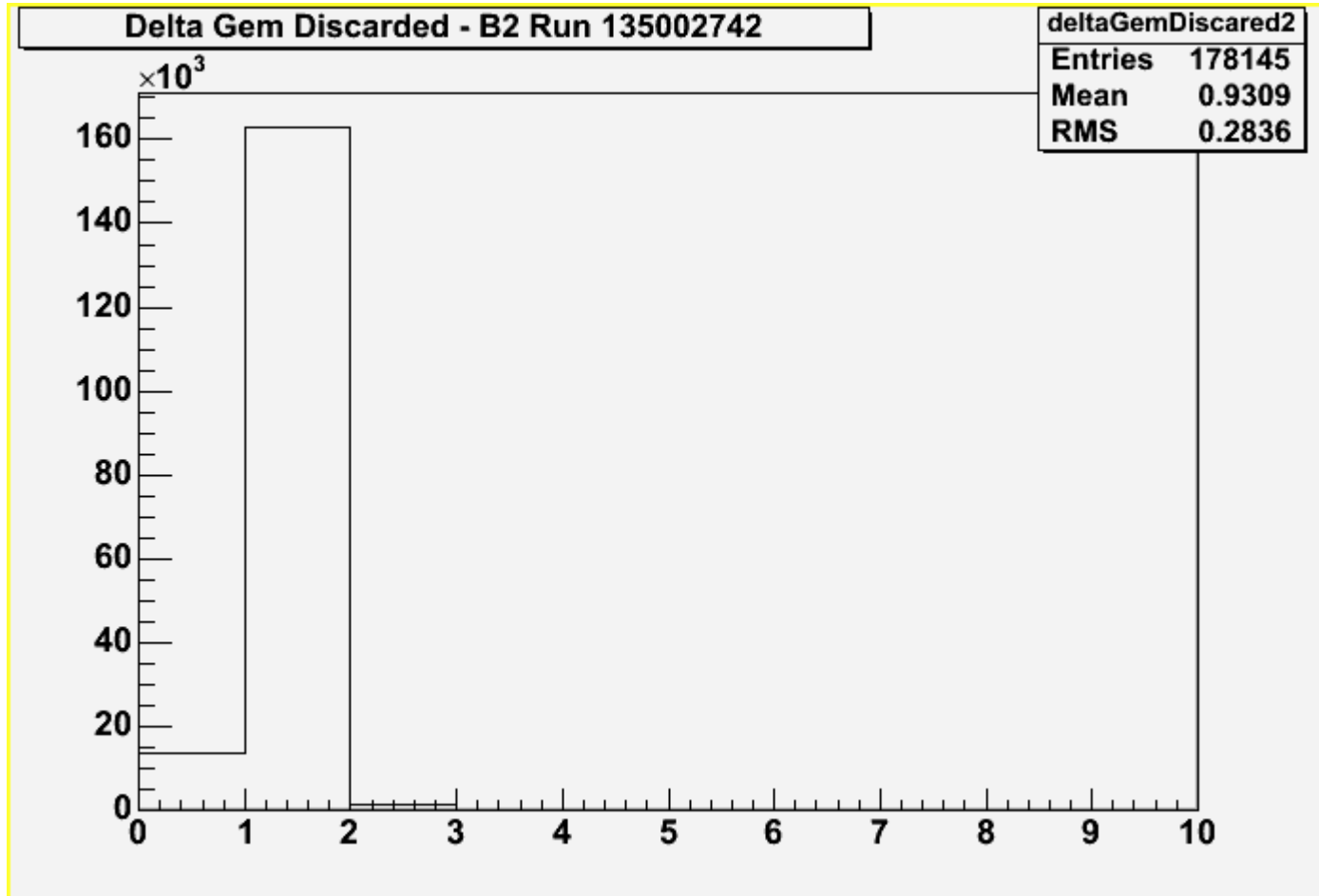
# Two Tower Data: End2End B2



Delta GemDiscarded still peaks at 0.

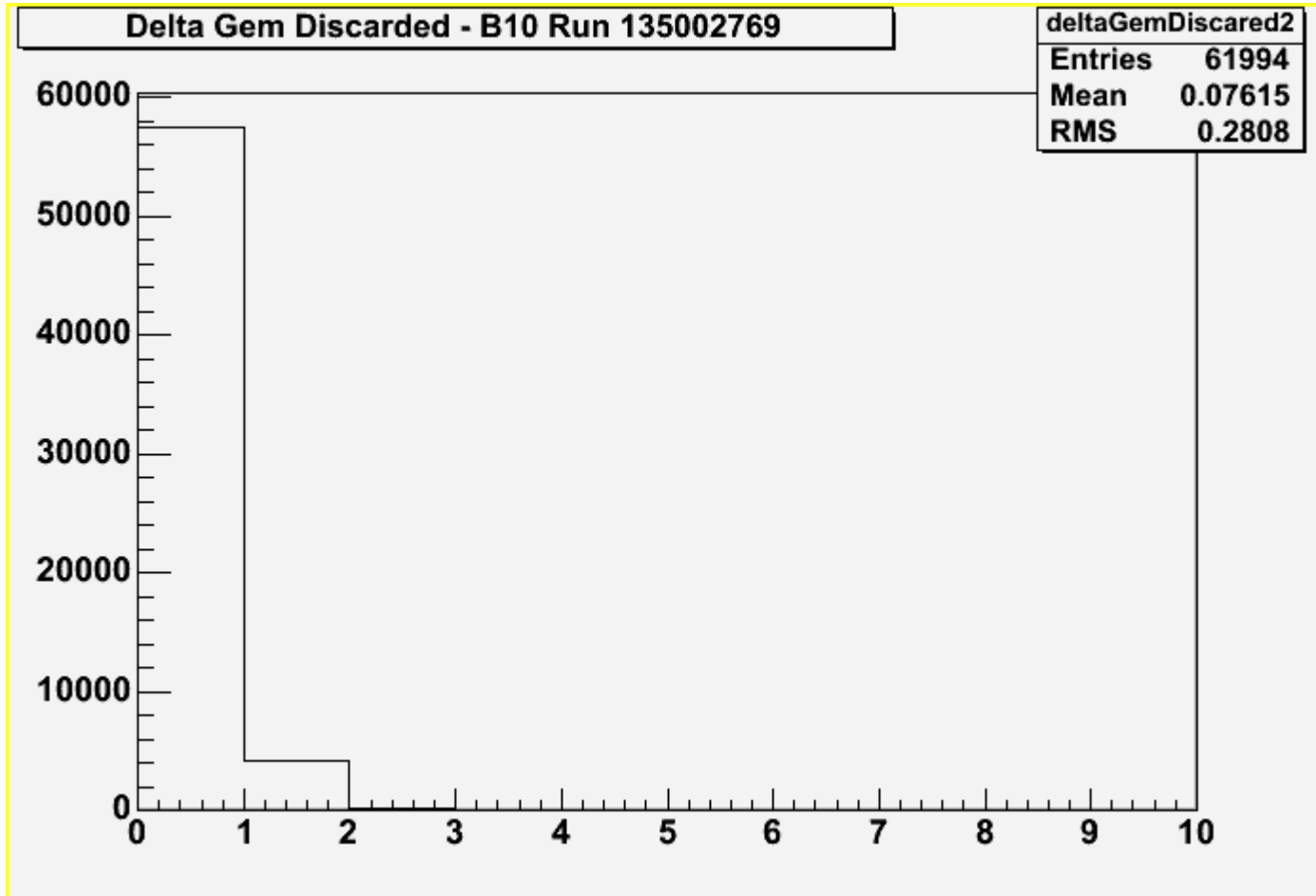
1% of the read out events have discarded events.

# Four Tower Data: B2



We nearly always have **one** discarded event per read out event!

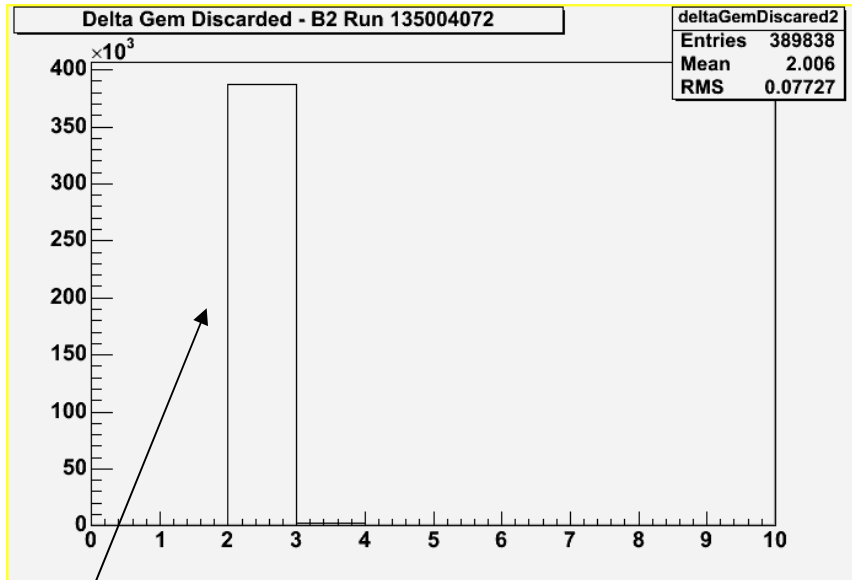
# Four Tower Data: B10



Delta GemDiscarded peaks at 0!

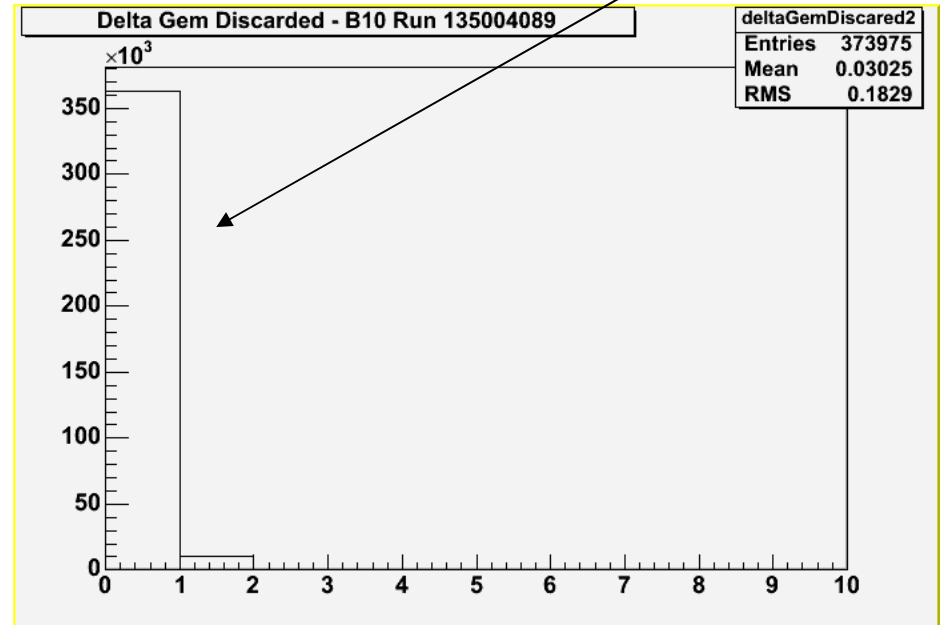


# Six Tower Data: B2 And B10

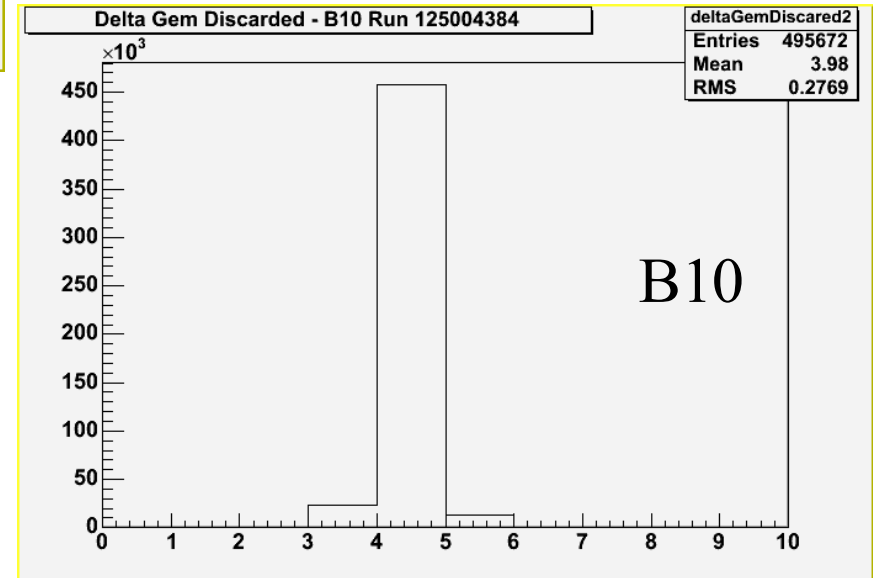
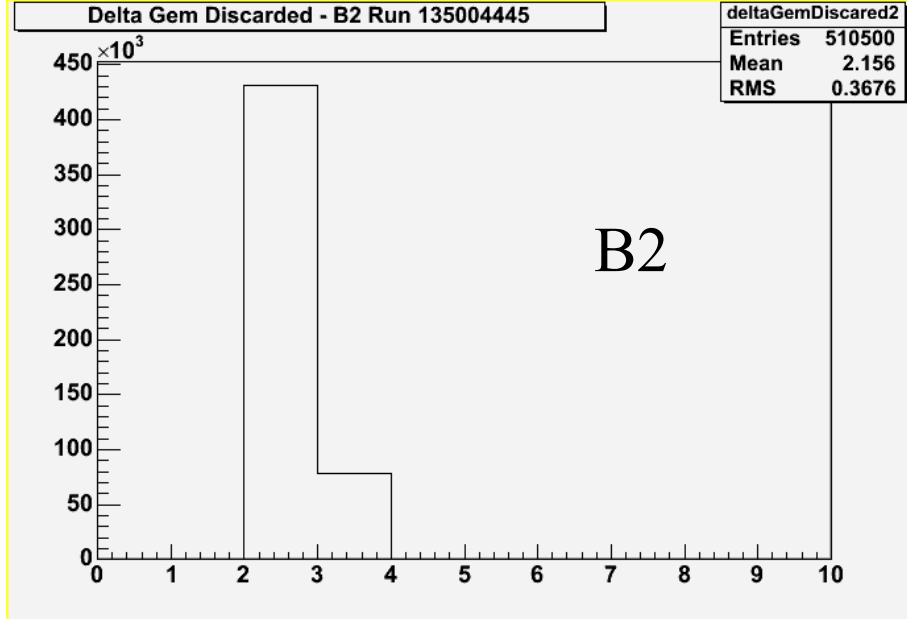


B2: Nearly always 2 discarded events per read out event! And we **always** have discarded events!

B10: Nearly no discarded events at all!



# Eight Tower Data: B2 And B10



We now have discarded events **all the time** for both run types!

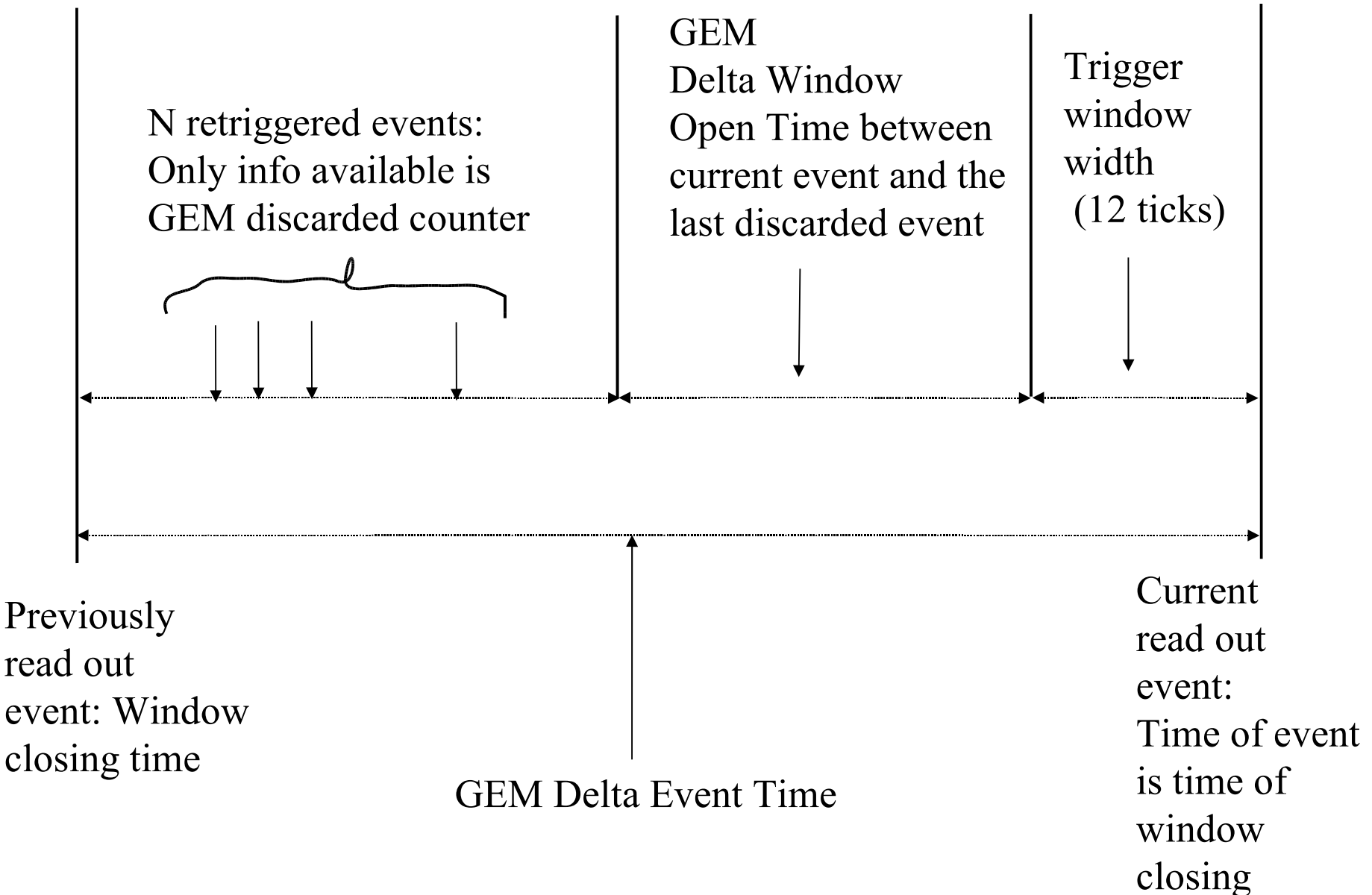


# Time Structure Of The Discarded Events

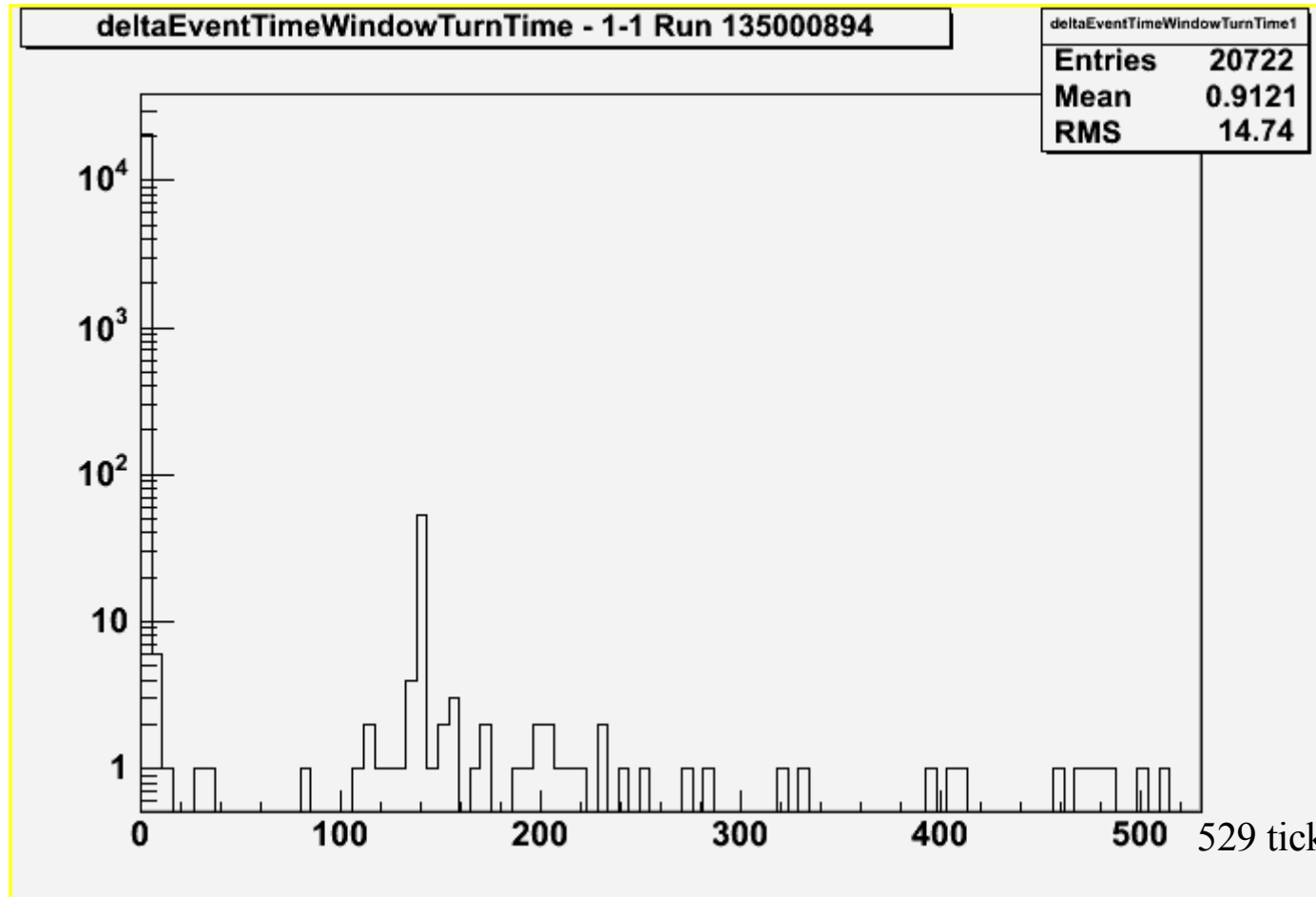
---

- Will plot:
  - **GemDeltaEventTime - GemDeltaWindowOpenTime**
- This gives us:
  - **The time between the previous read out event and the LAST discarded event!**
  - See cartoon on the next page.
  - This quantity will be 0 if there are no discarded events!
  - **NB! As the number of discarded events increases this time quantity will increase since we always look at the time of the last discarded event.**
- We don't know anything about the other discarded events except how many there are (from GemDiscarded).
- This time quantity is only useful for events where GemDeltaEventTime is not saturated (3.3 ms).

# Time Structure Of The Discarded Events

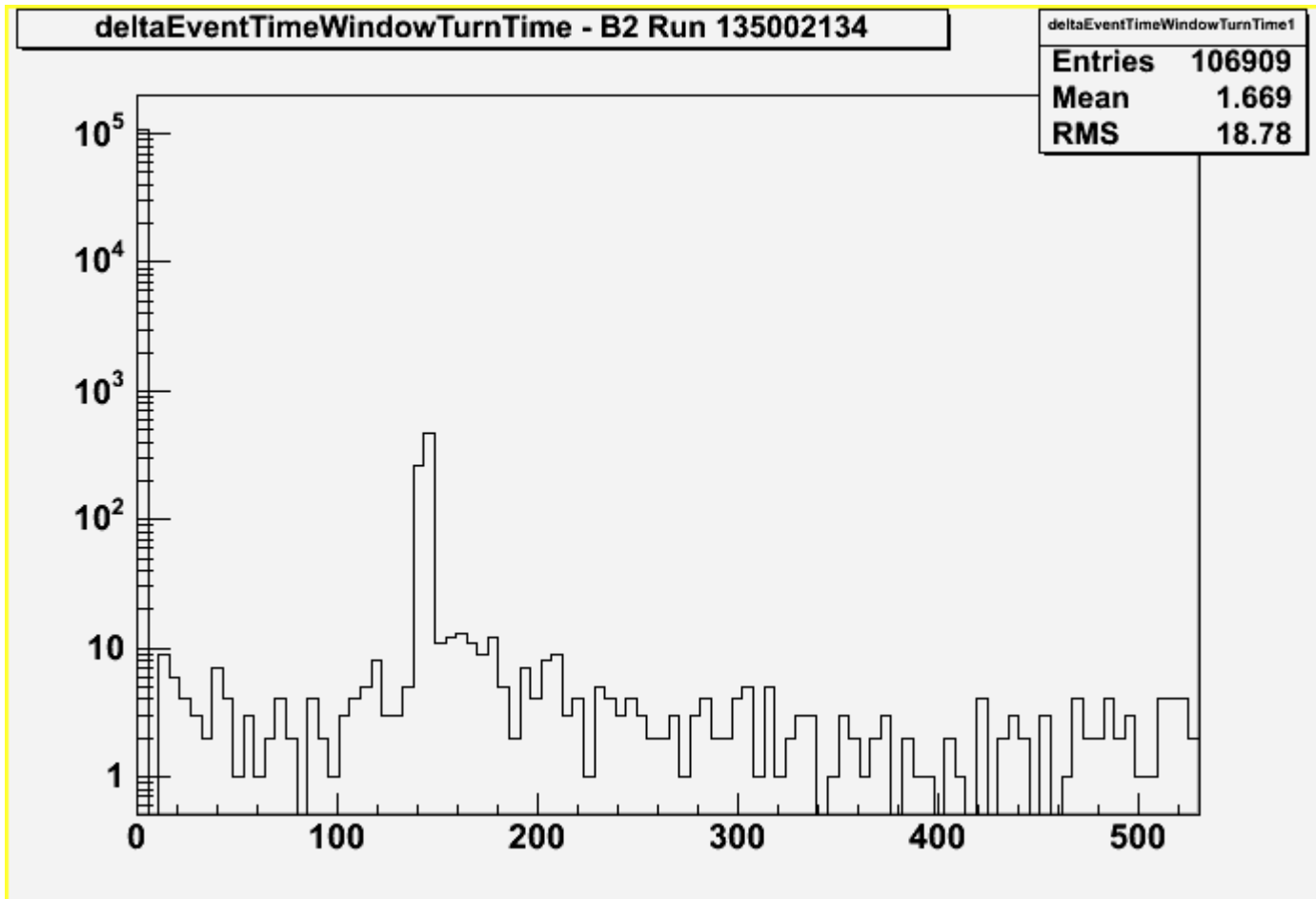


# One Tower Data: 1-1



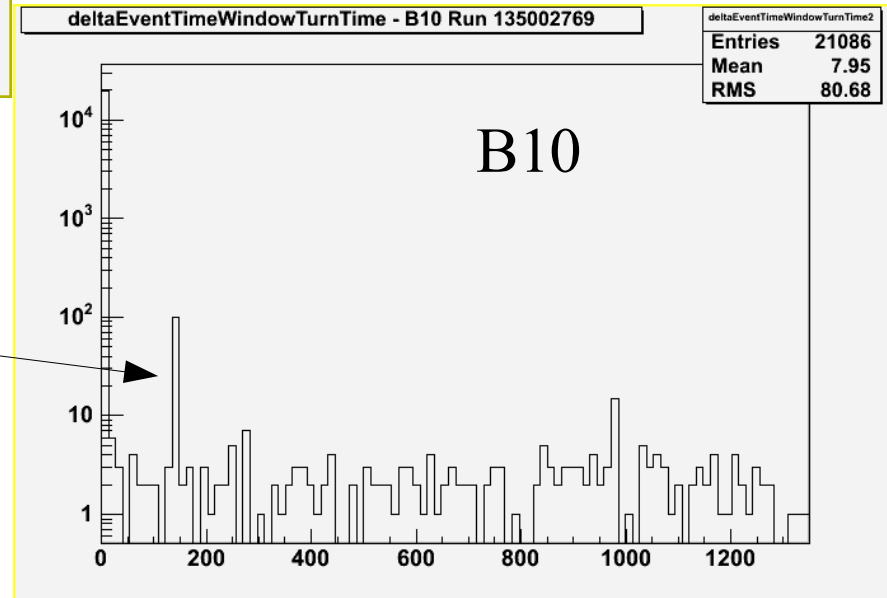
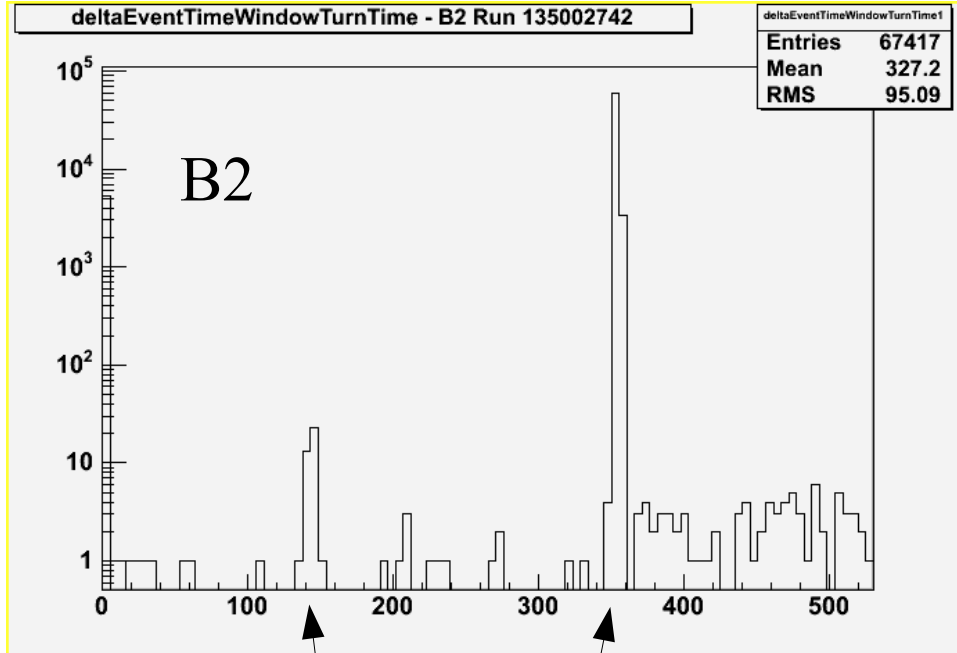
Remember: Not many discarded events for 1 tower data, but there is a peak around 140 ticks .....

# Two Tower Data: B2



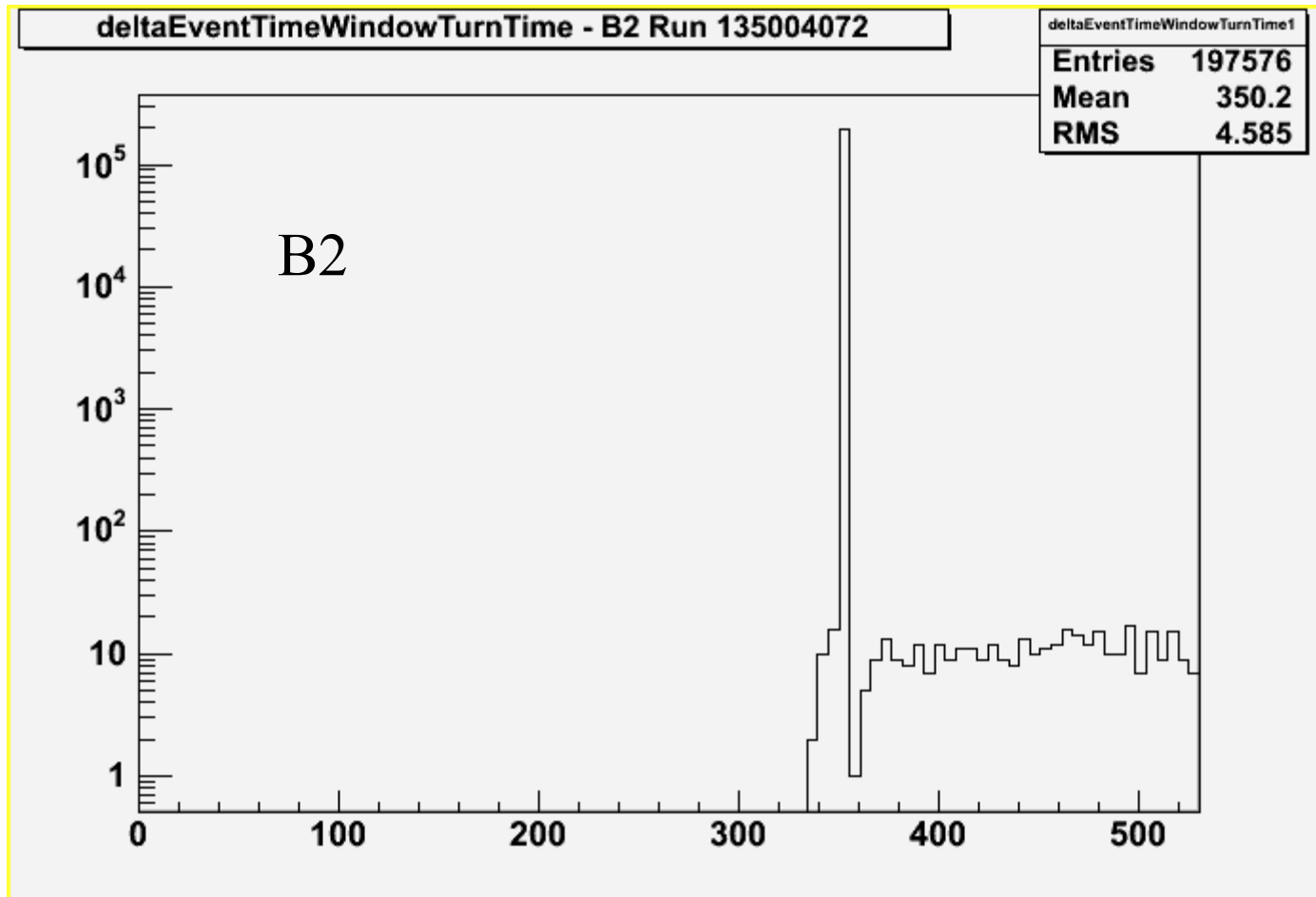
Definitively a peak around 140 ticks i.e. Even we we thought we had no discarded events we still have some.

# Four Tower Data: B2 And B10



New peak around 350 ticks.  
Peak at 140 is still there.

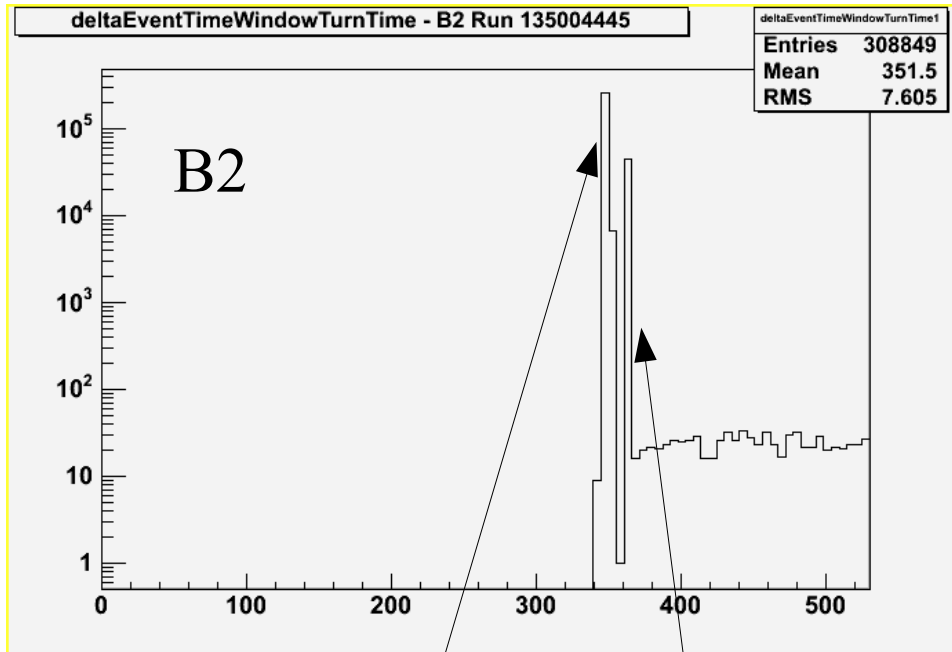
# Six Tower Data: B2



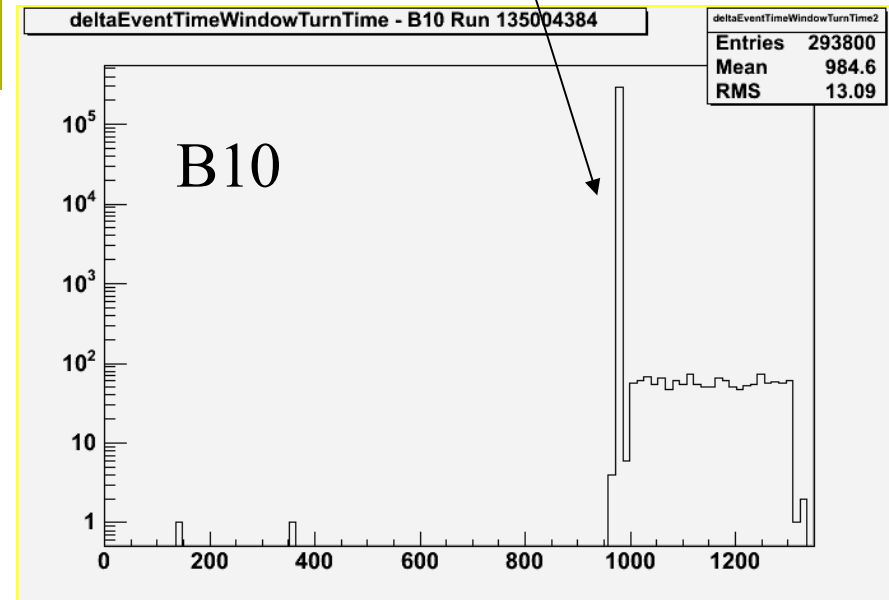
Remember: Now we **always** have discarded events.

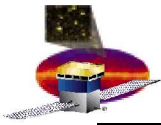


# Eight Tower Data: B2 And B10



Two peaks: 350 and 365 ticks

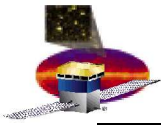




# STR 33

---

- We don't know what causes these discarded events.
- Suspected the CAL:
  - “Known” that when you read out the CAL you 'retrigger'.
- Special Test Request: STR 33
  - Take muon data in a B2 configuration
  - Turn off CAL LO
  - Turn off CAL HI
  - Turn of both CAL LO and CAL HI
- 'Turn off':
  - We don't allow it to open the trigger window.

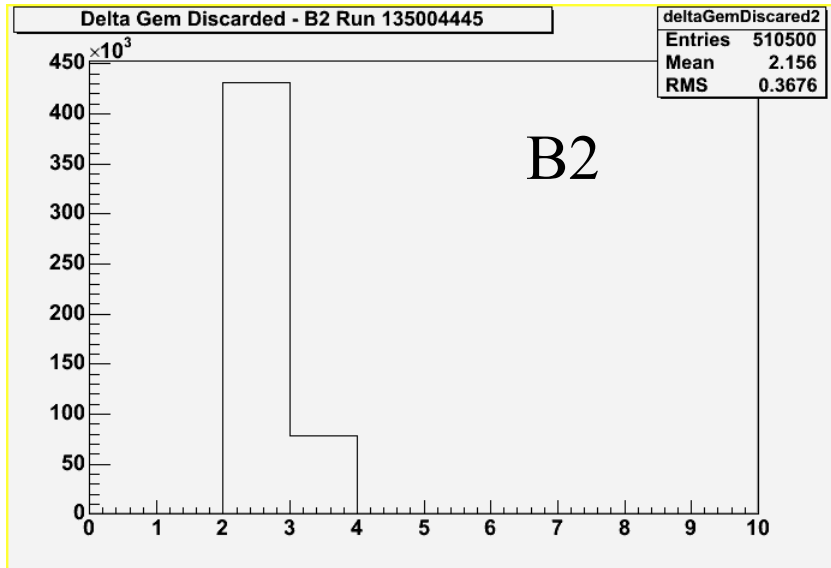


# STR 33: Results

---

- The number of discarded events can change with time for the same configuration (B2):
  - Their time distribution did not change!
- Turning off CAL LO:
  - Small decrease in the number of discarded events
- Turning off CAL HI:
  - Most discarded events disappear
- Turn off both CAL LO and CAL HI:
  - No discarded events!
  - So the discarded events are caused by the CAL triggers!
- Time peaks:
  - 350 ticks: Associated with CAL HI
  - 365 ticks: Associated with CAL LO

# STR 33: Baseline B2 Run

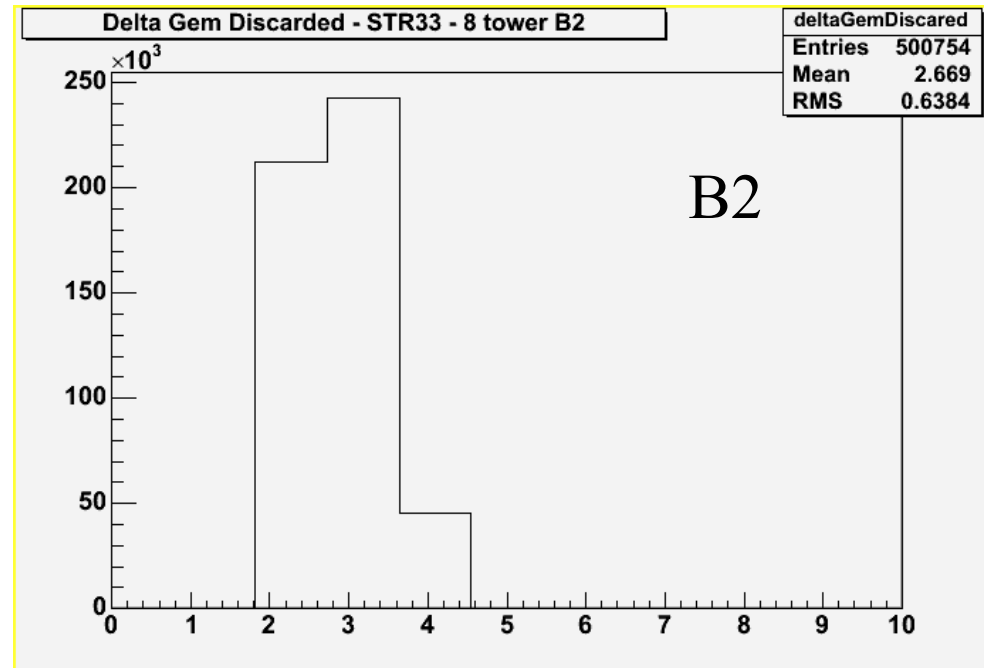


Old 8 tower B2 run

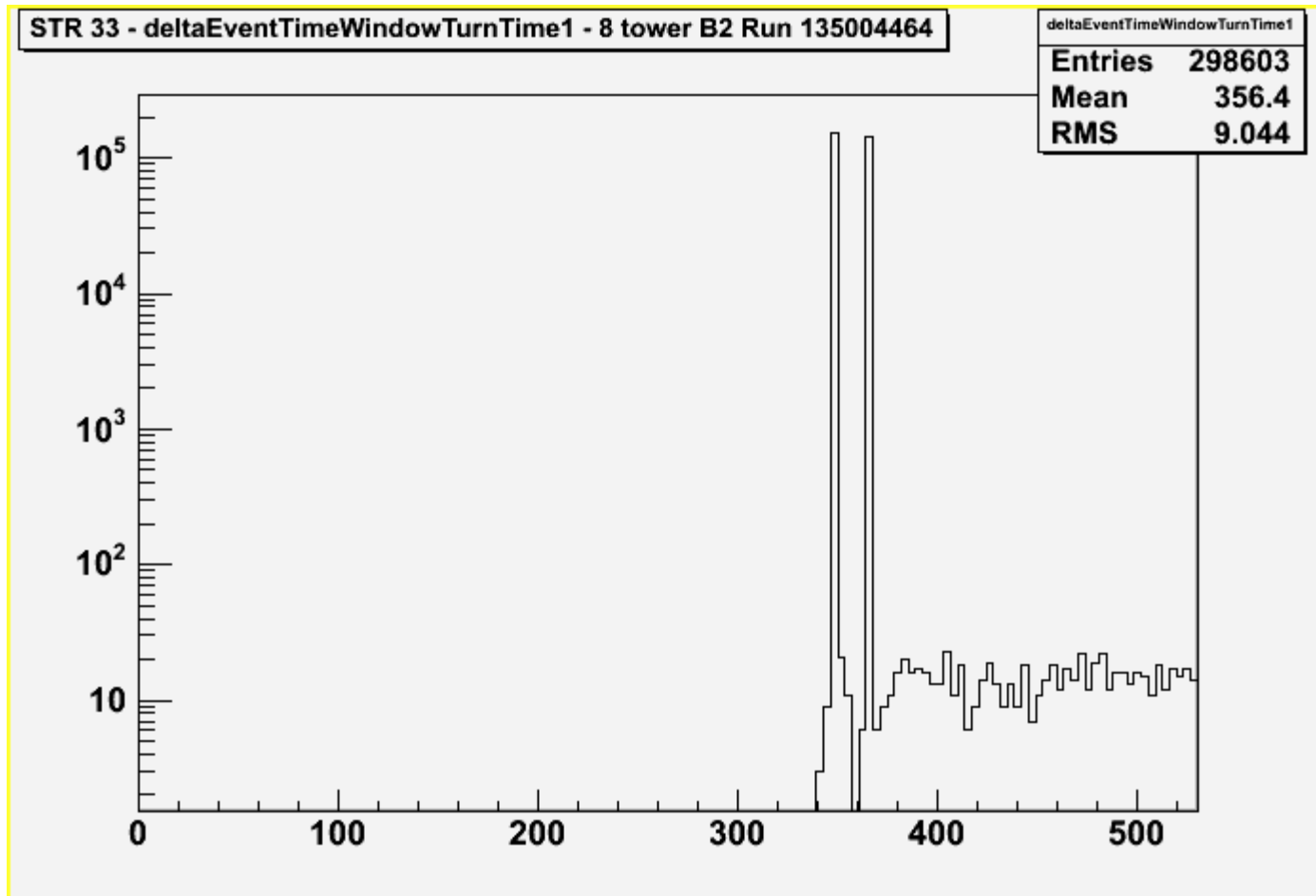
For the same configuration,  
the number of discarded events  
**changed!**

← The two runs were taken  
in the same week!

↓ STR Baseline B2 run

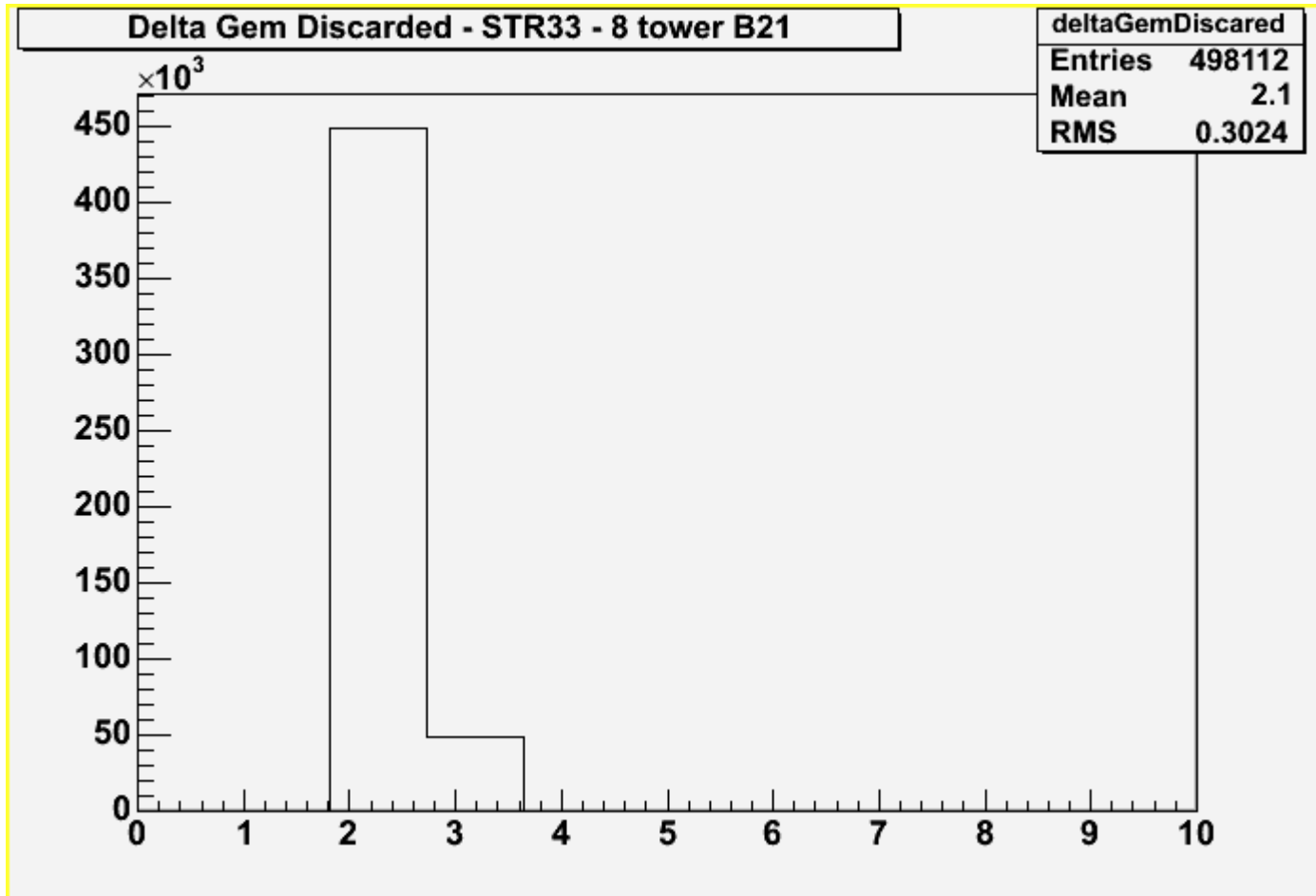


# STR 33: Baseline Run B2



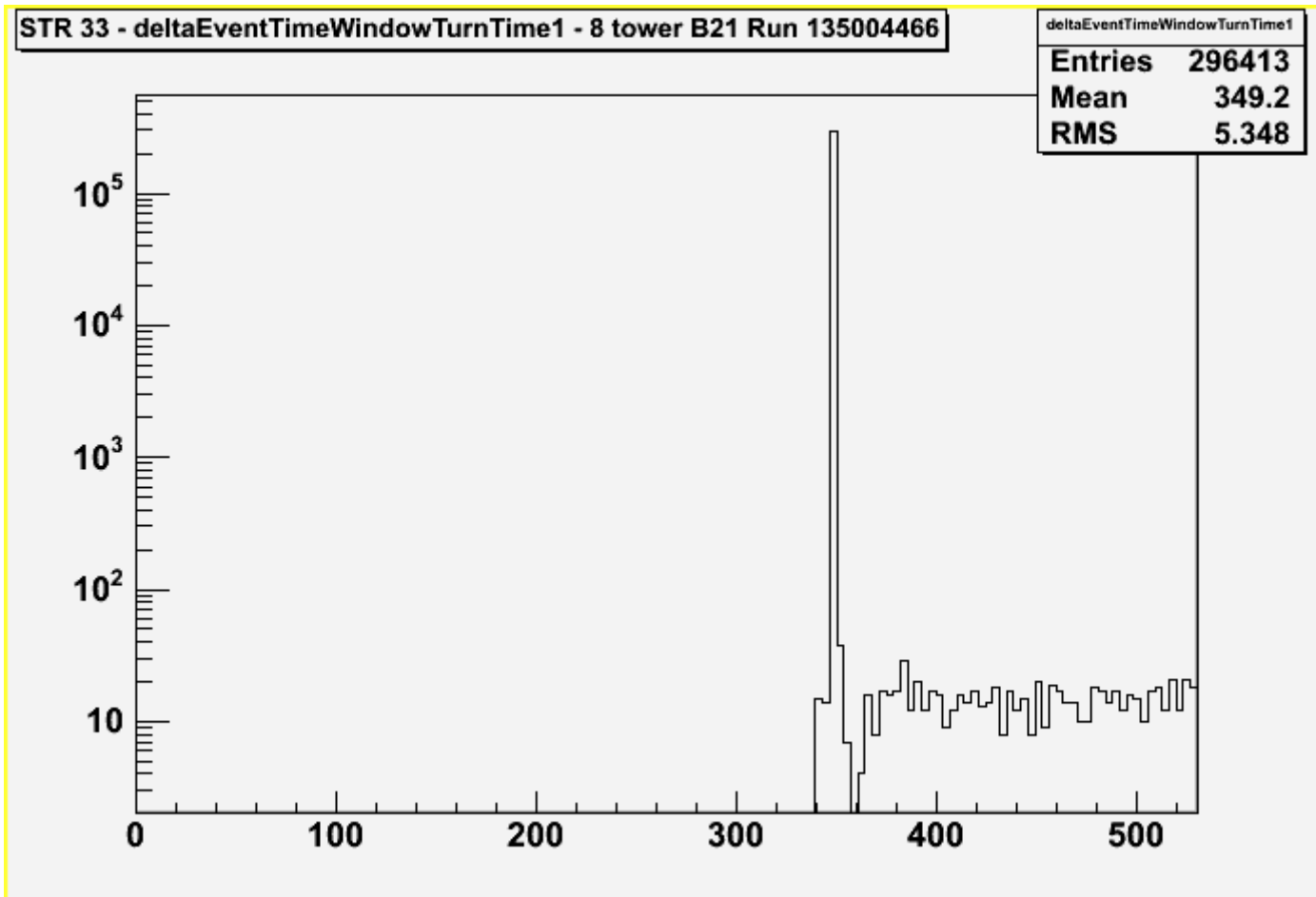
Time distribution did not change  
wrt previous 8 tower B2 run!

# STR 33: Turn Off CAL LO



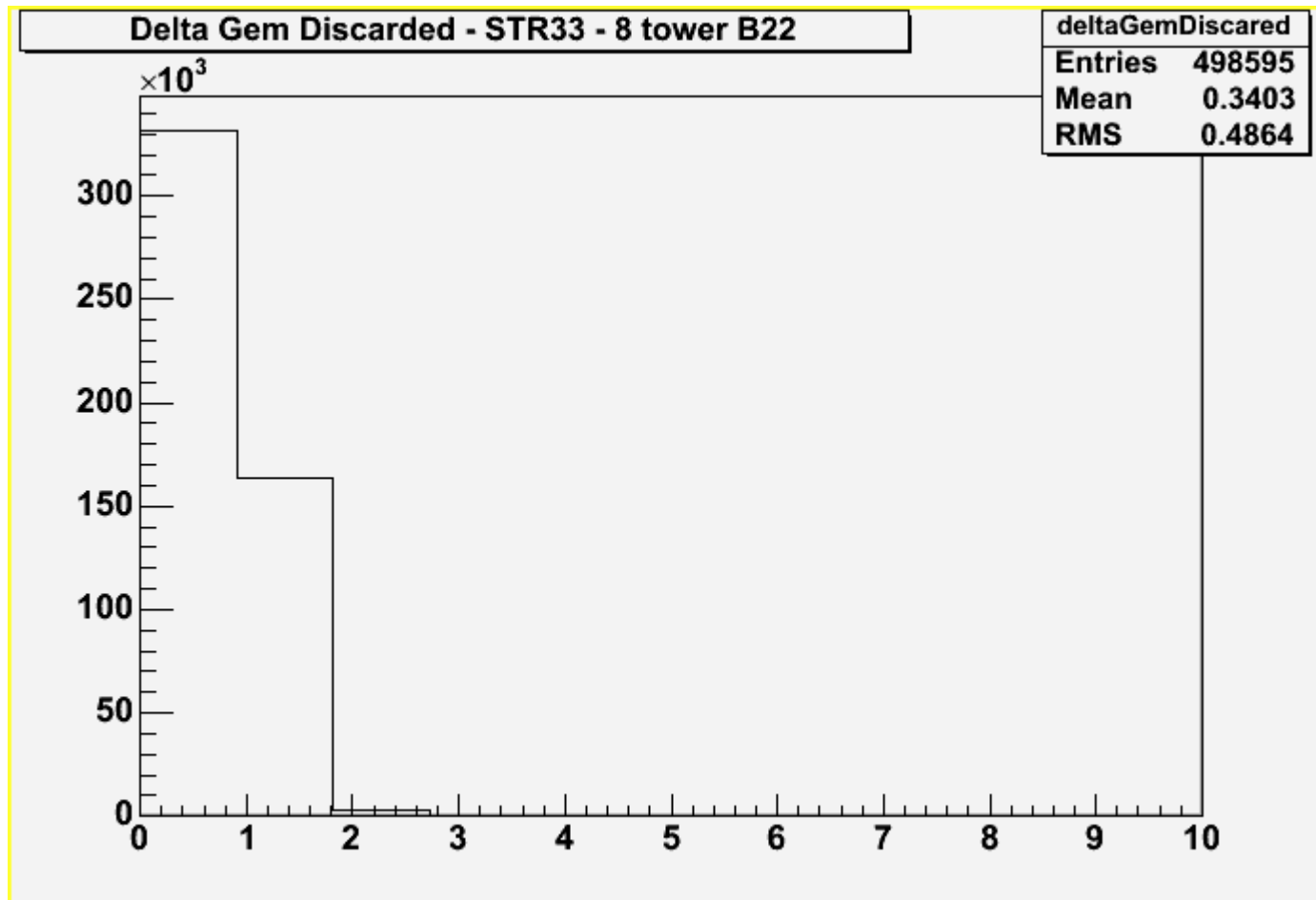
A small decrease in the number of discarded events

# STR 33: Turn Off CAL LO - Time



We see only the '350' peak i.e.  
'350' is associated with CAL HI.

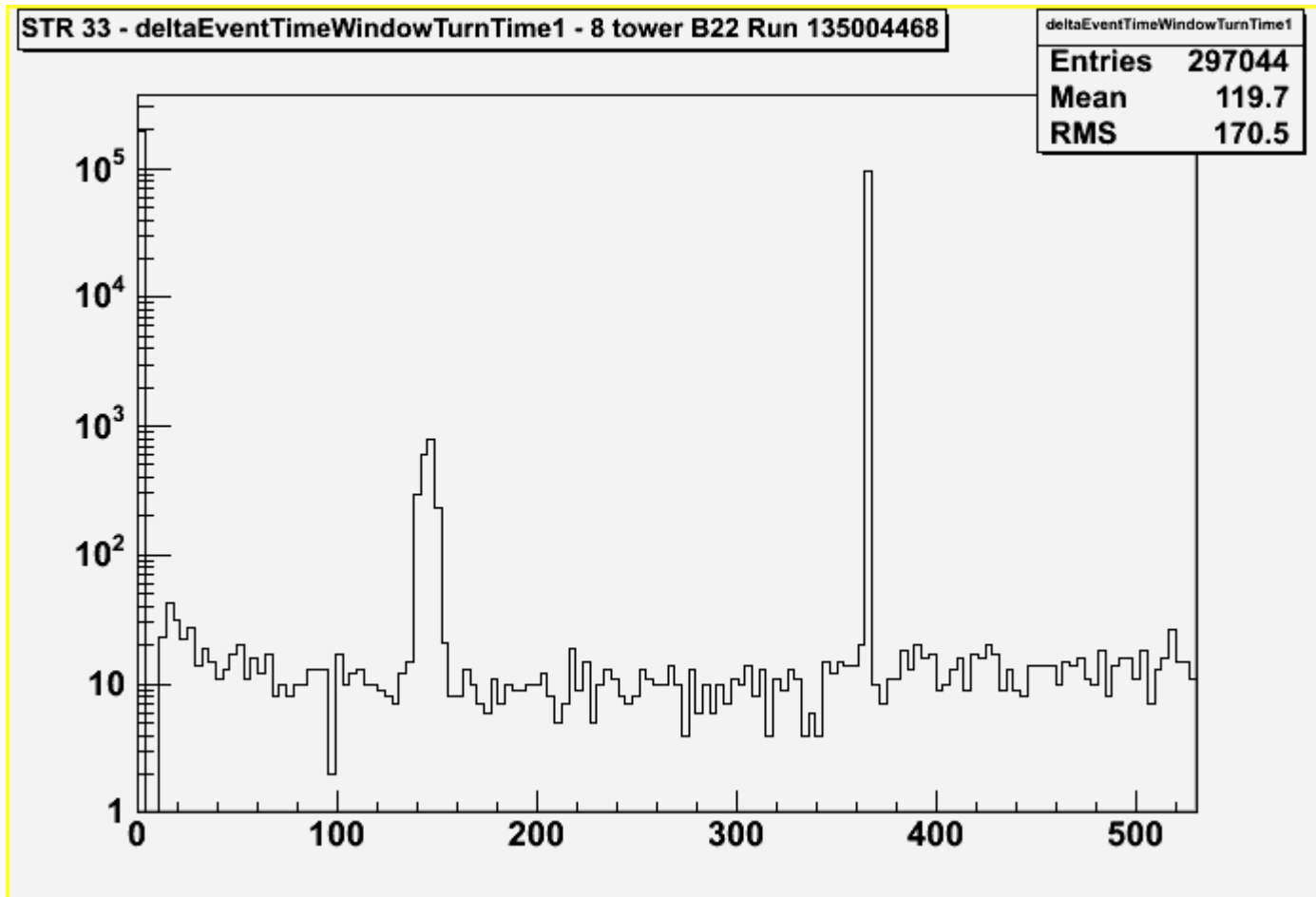
# STR 33: Turn Off CAL HI



A lot less discarded events!



# STR 33: Turn Off CAL HI - Time

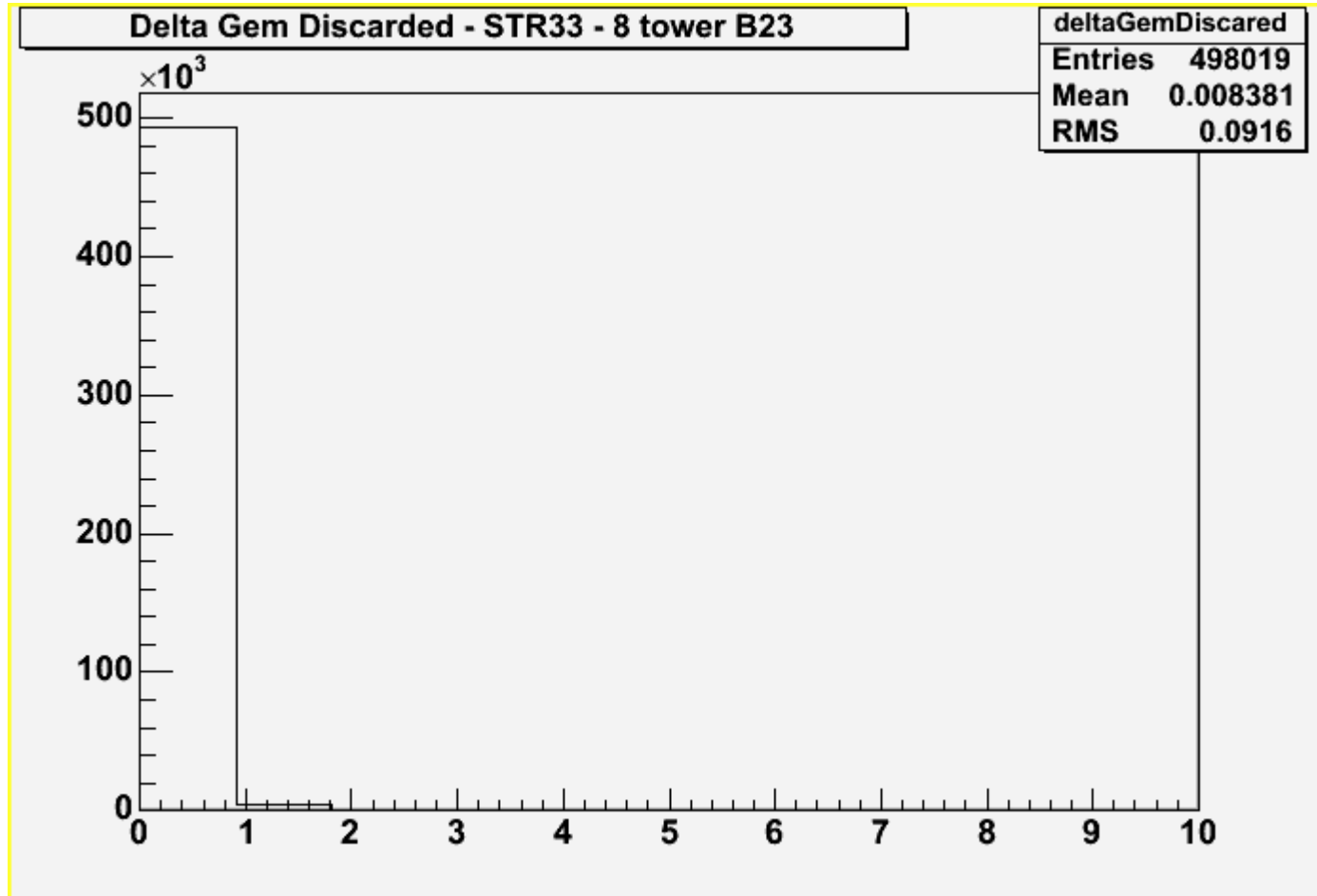


We see our old friend at 140 again .....

(consequence of having less discarded events(?))

And we still have the 365 peak.

# STR 33: Turn Off CAL LO And CAL HI

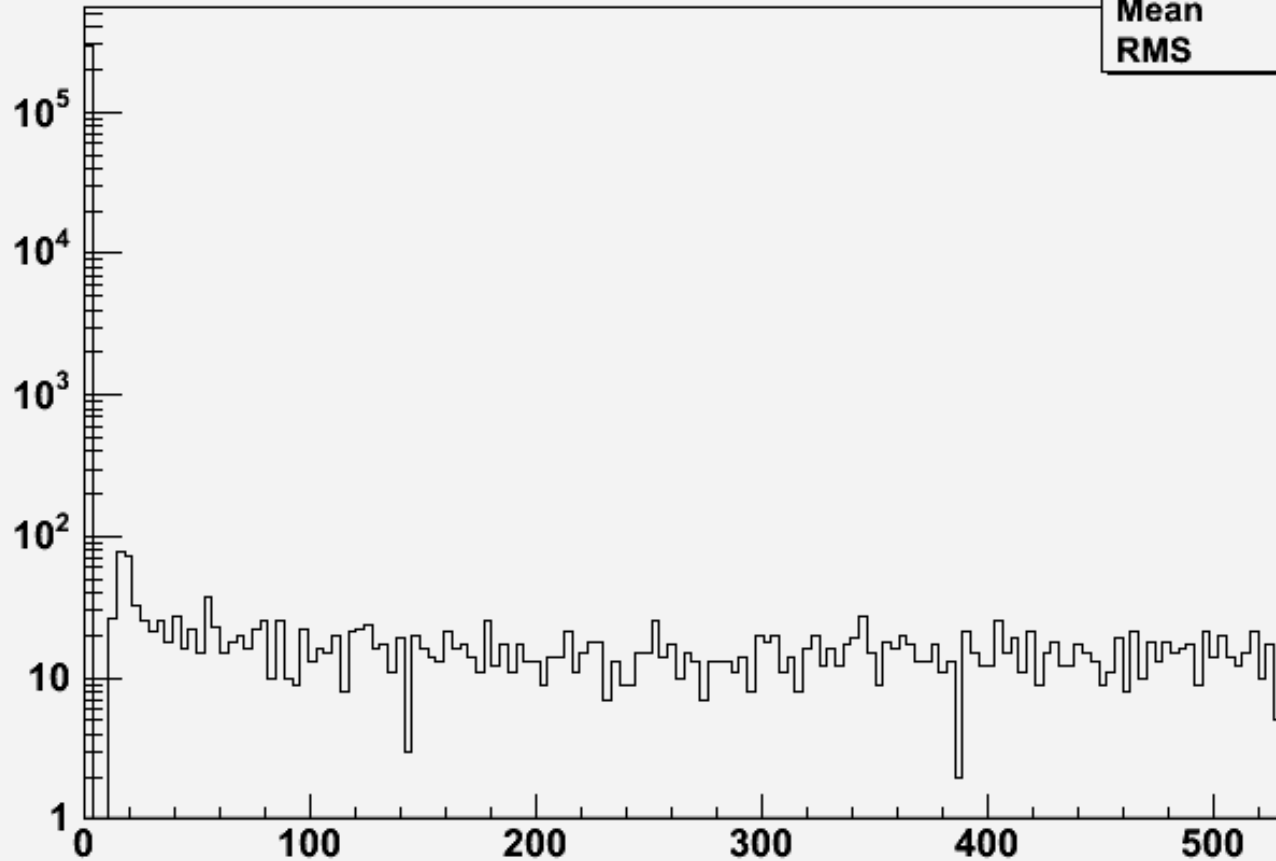


Very few discarded events left!

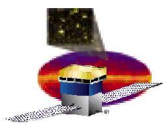
# STR 33: Turn Off CAL LO And CAL HI

STR 33 - deltaEventTimeWindowTurnTime1 - 8 tower B23 Run 135004470

deltaEventTimeWindowTurnTime1	
Entries	296645
Mean	1.997
RMS	26.29

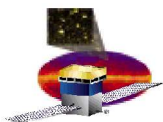


No peaks!



# STR 35

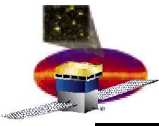
- Look at a single tower at a time:
  - We only power up one tower a time!
- Use an external pulser in addition to the usual physics triggers (TKR, CAL LO, CAL HI, Periodic) to decrease data taking time:
  - 1 kHz external pulser
- Take three runs per tower:
  - Baseline
  - Disable CAL LO
  - Disable CAL HI
- Because of time pressure we did not take:
  - Disable both CAL LO and HI
  - 8 tower baseline run
- We should have taken these runs!
- One thing to note:
  - TEM PS changed for Bay 0 and 4.
  - CAL modules have not been recalibrated since then!
  - Thresholds may not be entirely correct:
    - Effect is thought to be very small



# STR 35 Results

---

- Two modules do not have discarded events:
  - By this I mean a very, very low rate.
  - But they have peaks at 140 and 295.
- The other modules always have discarded events:
  - Bay 0: 1 discarded event per read out event
  - Bay 9: 2 and 3 discarded events per read out event
  - Bay 5, 8, 12, 13: 2 discarded events per read out event
- **No visible effect when we turn off CAL LO!**
- Sometimes the discarded events disappear when we turn off **CAL HI**, but sometimes there is **no change!**
- Time distributions:
  - We only see the time peak at 350 ticks.
  - 365 is not seen at all!
  - We see small peaks at 140 and 295 (new!) ticks when we have 'no' discarded events.

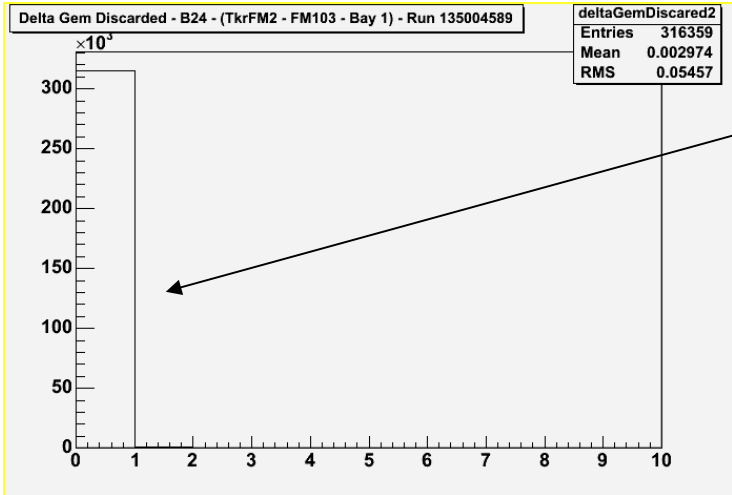
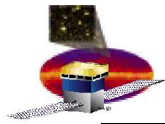


# STR 35 Results cont'

---

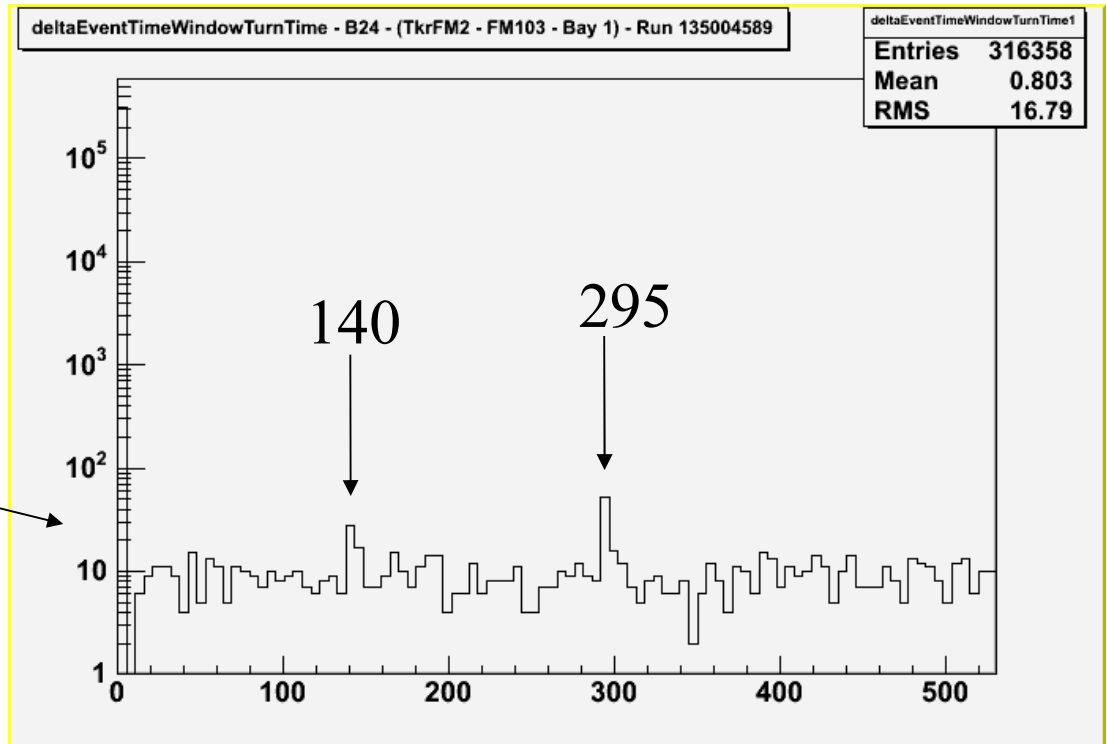
- **Bay 0:**
  - **March 2005: No discarded events**
  - **Now: Always discarded events**
    - **But remember the TEM PS change ....**
- **This means:**
  - **Most/All modules are affected:**
    - **What we see is not caused by one 'bad' module!**
  - **Looks like a module may change with time.**

# STR 35: Bay 1

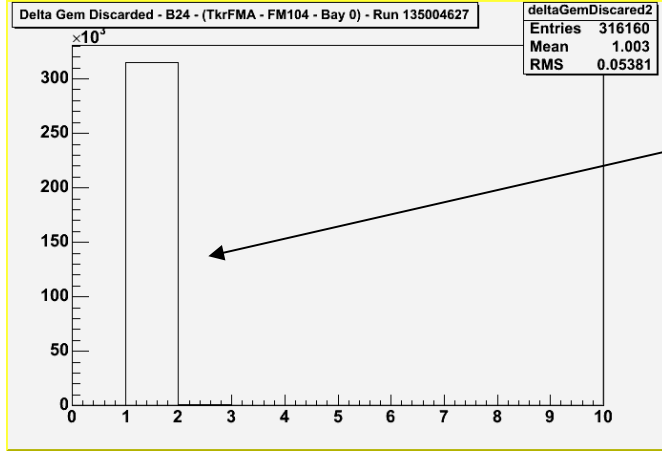


Delta Gem Discarded

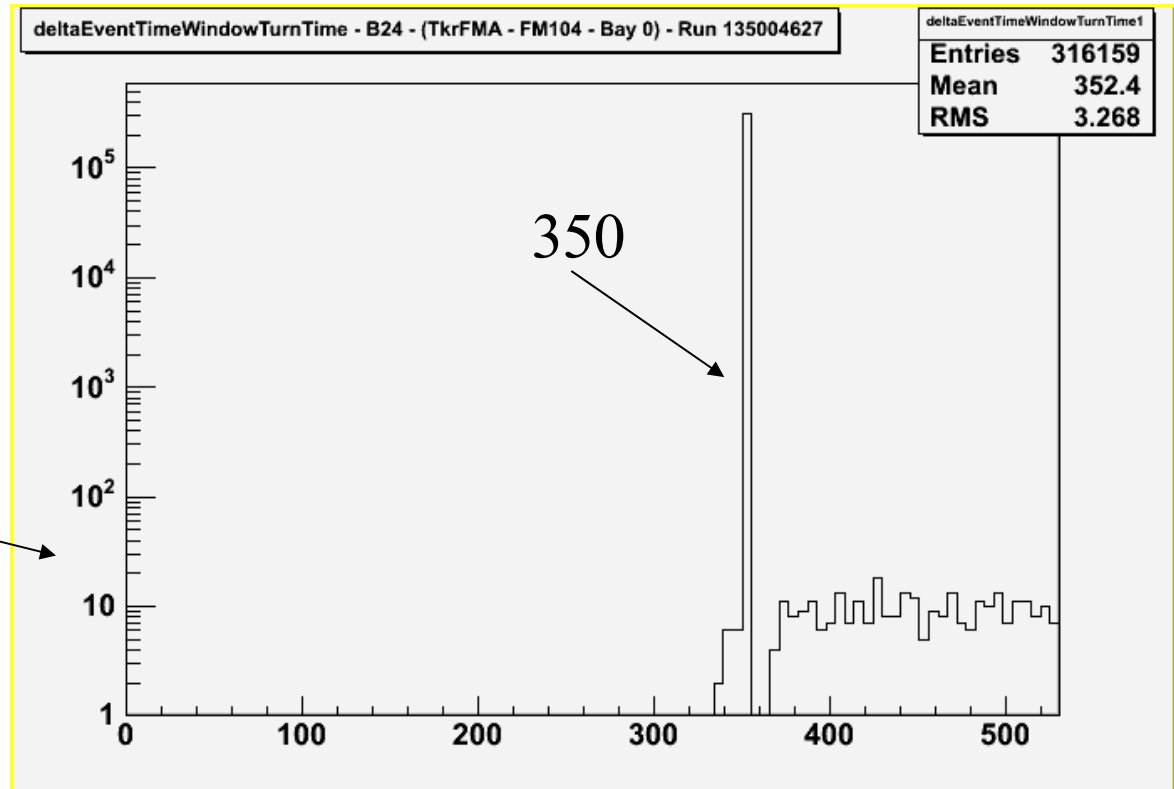
Time distribution



# STR 35: Bay 0



Delta Gem Discarded

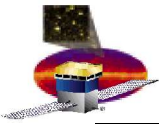


Time distribution



# CPT Runs: Single Module

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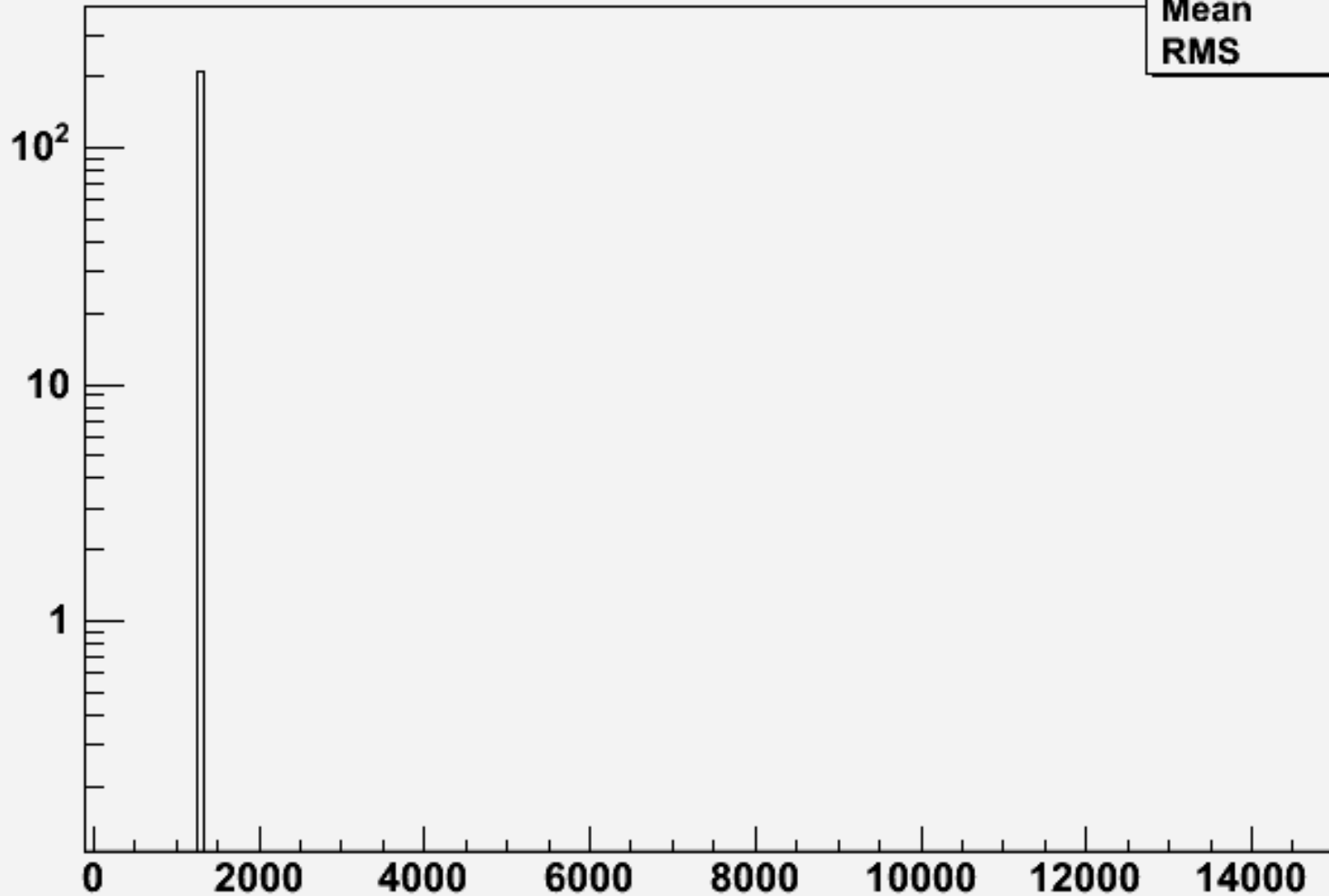


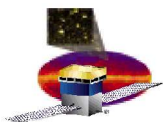
- Looked at CPT runs for the first six modules in the grid:
  - **calf\_mu\_optical:**
    - 4-range readout
    - Non-zero suppressed
    - FLE = 28
    - FHE = 127
  - Runs from May 28, 31 and June 17.
- Two groups:
  - Three modules 'always' have 13 discarded events per read out event.
  - Three modules 'always' have 21 discarded events per read out event.
- **All six modules have discarded events!**
- Time distribution:
  - All (the last) discarded events come at 1325 ticks
  - Deadtime for this run: 13129 ticks

# CPT Runs: Time Distribution

deltaEventTimeWindowTurnTime - calf\_mu\_optical - FM104 - 2005-06-17 - Run 135002992

deltaEventTimeWindowTurnTime	
Entries	210
Mean	1325
RMS	0.7866

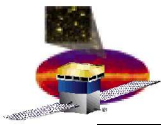




# Summary

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- As of 8 towers we **always** have **discarded events** when we take data.
- They are coming from the **CAL triggers**:
  - **Mainly CAL HI**
- All modules seem to have this problem.
- The discarded events occur at very specific times.
- Number of discarded events (in a module) can change with time!
- Do this cause real retriggers?
  - **Just from the low number of CAL triggers in muon runs we know it's at least not a big problem!**
  - **We are working on a more detailed analysis of the CAL trigger rate**
    - **Any deviation from Poisson?**
  - **This will in any case be part of the monitoring we will do on orbit:**
    - **For all trigger sources**



# Requests

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- **Threshold dependent?**
  - **Need to do a threshold scan (of CAL HI).**
  - **This is in any case planned:**
    - **Because of traditional CAL retriggering worries**
    - **So no additional data taking necessary**
  - **Should be done on the complete Instrument with FSW in January:**
    - **We are characterizing the full instrument**
- **Redo STR 35?**
  - **Useful to redo STR 35 on same 8 towers to monitor changes with time.**
  - **Requires no Online resources**
  - **Should only be done if there is an opportunity before FSW:**
    - **Doesn't depend on the number of towers in the grid.**
  - **And only if it doesn't delay anything!**
- **Explanation of the source of the problem:**
  - **Time for Eric Grove to talk .....**